REMARKS

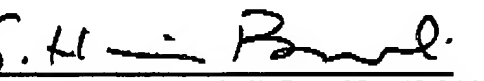
In the Office Action dated March 15, 2006, the Examiner states that a copy of document 99-0156 was not included in the response filed March 1, 2006. In response, attached is a copy of document 99-0156 to complete the response.

REQUEST FOR ALLOWANCE

In view of the foregoing, Applicant submits that all pending claims in the application are patentable. Accordingly, reconsideration and allowance of this application are earnestly solicited. Should any issues remain unresolved, the Examiner is encouraged to telephone the undersigned at the number provided below.

Respectfully submitted,

Dated: May 10, 2006

By: 

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QUALCOMM INCORPORATED
INVENTION DISCLOSURE

ID NO.: 99-0156

The invention herein described was evolved during the course of my employment and is being submitted pursuant to the terms of the Employee Agreement signed by me.

1. TITLE OF INVENTION: Interleaving for Multiple Transmitters .

2. PURPOSE OF INVENTION: To provide an effective method of adding time diversity to a signal that is transmitted from more than one transmitter such as in a multicarrier or OTD transmission system .

3. CONCEPTION:
Invention conceived on: (Insert Date Here) .
This disclosure written on: 12-23-98.

4. REDUCTION TO PRACTICE, if any:
Construction of device started on: (Insert Date Here) .
Device completed on : (Insert Date Here) .
Device tested on : (Insert Date Here) .

5. BRIEF DESCRIPTION: (See Attached) .

Incorporated herein and forming a part of this disclosure are the following:

Additional Sheets (Yes.) Papers (No.) Photographs (No.) Prints (No.)

6. Indicate whether invention conceived or reduced to practice under:

(a) Government or other contract? Yes___ No X___ if yes,

(I) Project Name: (Insert Project Name Here) .

(II) Account Charged: (Insert Account Charged Here) .

(b) Company funded? Yes X No___ if yes,

(I) Project Name: Standards .

(II) Account Charged: (Insert Account Charged Here) .

7. IDENTIFY ANY ANTICIPATED OR PAST PUBLICATIONS, OFFERS FOR SALE, REPORTS, PROPOSALS, OR OTHER TYPE OF DISCLOSURE WHETHER WRITTEN OR ORAL THAT WILL BE MADE OUTSIDE OF THE COMPANY.

(Insert Disclosure Information Here) .

8. INVENTOR(s):

	Stein Lundby	
Inventor Signature	Inventor Printed Name	Date
Inventor Signature	Inventor Printed Name	Date
Inventor Signature	Inventor Printed Name	Date

9. WITNESSES:

The invention was disclosed to me by the above inventor(s).

The description was examined and is clearly understood.

	Sean English	
Witness Signature	Witness Printed Name	Date
Witness Signature	Witness Printed Name	Date

Keith Saints Stein Lundby

Interleaving for Multiple Transmitters

Antenna transmit diversity as well as multi-carrier transmission are promising new technologies that improve transmission resistance to fading by offering space and/or frequency diversity. In the antenna transmit diversity case for example, the data to be transmitted is encoded into symbols Si, then distributed among the antennas and transmitted. Note that to avoid the different antennas from interfering each other several techniques have been proposed, such as Delay Transmit Diversity, OTD, TSTD, TDTD, Multi-Carrier transmit diversity, etc. but they all share the same basic idea.
In addition the multi-carrier transmission, whether it uses antenna transmit diversity or not, must distribute the coded symbols among the different carriers, which is similar to distributing symbols among several antennas in an antenna transmit diversity system.

The problem of interleaving for transmit diversity is that we wish to fully utilize the gain offered by transmit diversity by proper interleaving, as well as making sure that the interleaver also performs well when the antennas become correlated. This is not always obvious.

Suppose we have a source frame F composed of N coded symbols Si (1<i<N). Suppose also that we have to distribute these symbols Si over M transmitters (different carriers or antennas or both).
We suggest in this invention that the symbols be split into M groups Gj (1<j<M), one for each transmitter. Then each of the groups Gj be interleaved independently. This is already described in Yu-Cheun Jou's patent xxx of last year.

The problem that happens is that if the interleavers and splitter are not chosen correctly or even worse if they are all identical, the performance will be severely degraded when the signals from the different transmitters go through channels that are correlated.

Typically there are 2 transmitters that lead to 2 antennas, and the splitter simply consists in a demux operation that send odd symbols to G1 and even symbols to G2, and typically the interleavers for G1 and G2 are identical. In that case if there is no shuffle the system's performance will be severely degraded when the fading on the paths from antenna 1 and 2 are correlated.

What we propose of new in this disclosure is the shuffle. The goal of the shuffle is to make sure that even if the different transmission paths from the different transmitters become correlated, the performance degradation is minor.
One particularly efficient implementation of the shuffle that each shuffle cyclically rotates the symbols it receives. Here is an example:

Shuffler j: cyclically rotate the symbols to be transmitted by transmitter j by (j-1)*N/M symbols.

Numerical example:
If N= 4, M=2 and G2 after interleaving is "abcd", then shuffler 2 would output "cdab", which is "abcd" that has been cyclically rotated by N/M=2 symbols.

Another example of a shuffler is a flip. This would transform "abcd" into "dcba".

Note that in the figure the shuffle operations are shown to be after the interleavers, but in reality both would probably be combined in a real implementation.

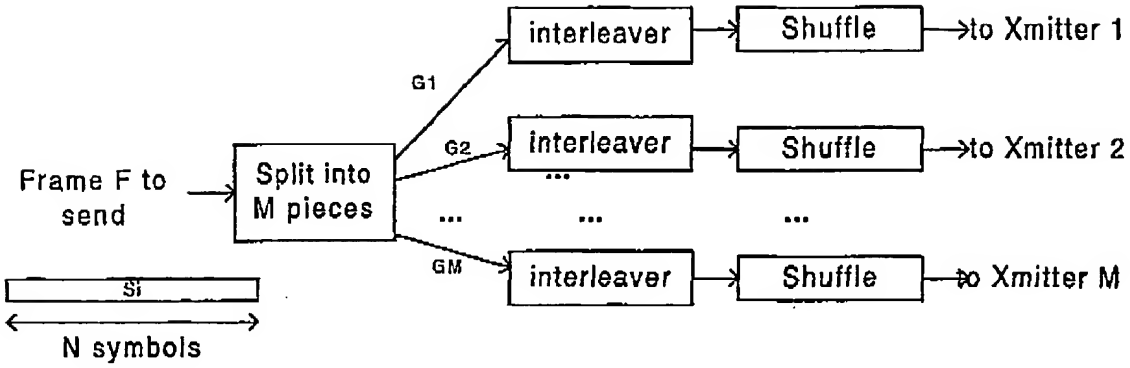
interleaver
Shuffle
to Xmitter 1
G1
G2
interleaver
Shuffle
to Xmitter 2
Frame F to send
Split into M pieces
GM
interleaver
Shuffle
to Xmitter M
Si
N symbols

Figure 1